NIST TIME AND FREQUENCY BULLETIN

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1. GENERAL BACKGROUND INFORMATION

ACRONYMS AND ABBREVIATIONS USED IN THIS BULLETIN

ACTS	- Automated Computer Time Service		
BIPM	- Bureau International des Poids et Mesures		
CS	- Cesium Standard		
GPS	- Global Positioning System		
IERS	- International Earth Rotation Service		
LORAN	- Long Range Navigation		
MC	- Master Clock		
MJD	- Modified Julian Date		
NIST	- National Institute of Standards and Technology		
NOAA	- National Oceanic and Atmospheric Administration		
NVLAP	- National Voluntary Laboratory Accreditation Program	ns	- nanosecond
SI	- International System of Units	µs	- microsecond
TA	- Atomic Time	ms	- millisecond
TAI	- International Atomic Time	s	- second
USNO	- United States Naval Observatory	min	- minute
UTC	- Coordinated Universal Time		

2. TIME SCALE INFORMATION

The values listed below are based on data from the IERS, the USNO, and NIST. The UTC(USNO,MC) - UTC(NIST) values are averaged measurements from all available common-view GPS satellites (see bibliography on page 5). UTC - UTC(NIST) data are on page 3.

0000 HOURS COORDINATED UNIVERSAL TIME			
JUN 2012	MJD	UT1-UTC(NIST) (±5 ms)	UTC(USNO,MC) - UTC(NIST) (±20 ns)
7	56085	-578 ms	+9 ns
14	56092	-584 ms	+8 ns
21	56099	-584 ms	+7 ns
28	56106	-586 ms	+5 ns

The master clock pulses used by the WWV, WWVH, and WWVB time-code transmissions are referenced to the UTC(NIST) time scale. Occasionally, 1 s is added to the UTC time scale. This second is called a leap second. Its purpose is to keep the UTC time scale within ±0.9 s of the UT1 astronomical time scale, which changes slightly due to variations in the Earth's period of rotation.

NOTE: A positive leap second was added at the end of June 2012.

Positive leap seconds, beginning at 23 h 59 min 60 s UTC and ending at 0 h 0 min 0 s UTC, were inserted in the UTC time scale on 30 June 1972, 1981-1983, 1985, 1992-1994, 1997, and 2012, and on 31 December 1972-1979, 1987, 1989, 1990,1995, 1998, 2005, and 2008.

The use of leap seconds ensures that UT1 - UTC will always be held within ±0.9 s. The current value of UT1 - UTC is called the DUT1 correction. DUT1 corrections are broadcast by WWV, WWVH, WWVB, and ACTS and are printed below. These corrections may be added to received UTC time signals in order to obtain UT1.

DUT1 = UT1 - UTC =

+ 0.4 s beginning 0000 UTC 01 July 2012
- 0.6 s beginning 0000 UTC 10 May 2012
- 0.5 s beginning 0000 UTC 09 February 2012
- 0.4 s beginning 0000 UTC 04 November 2011
- 0.3 s beginning 0000 UTC 12 May 2011
- 0.2 s beginning 0000 UTC 06 January 2011
- 0.1 s beginning 0000 UTC 03 June 2010
+0.0 s beginning 0000 UTC 11 March 2010
+0.1 s beginning 0000 UTC 12 November 2009
+0.2 s beginning 0000 UTC 11 June 2009
+0.3 s beginning 0000 UTC 12 March 2009

The difference between UTC(NIST) and UTC has been within ±100 ns since July 6, 1994. The table below shows values of UTC - UTC(NIST) as supplied by the BIPM in their *Circular T* publication for the most recent 310-day period in which data are available. Data are given at ten-day intervals. Five-day interval data are available in *Circular T*.

0000 Hours Coordinated Universal Time		
DATE	MJD	UTC-UTC(NIST) ns
May 22, 2012	56069	10.2
May 12, 2012	56059	9.1
May 2, 2012	56049	7.0
Apr. 22, 2012	56039	4.1
Apr. 12, 2012	56029	0.9
Apr. 2, 2012	56019	-0.6
Mar. 23, 2012	56009	-1.9
Mar. 13, 2012	55999	-2.3
Mar. 3, 2012	55989	-3.4
Feb 22, 2012	55979	-4.7
Feb 12, 2012	55969	-2.7
Feb. 2, 2012	55959	-0.8
Jan. 23, 2012	55949	1.4
Jan. 13, 2012	55939	2.7
Jan. 3 2012	55929	4.5
Dec 24, 2011	55919	5.8
Dec 14, 2011	55909	5.6
Dec 4, 2011	55899	5.0
Nov 24, 2011	55889	3.0
Nov. 14, 2011	55879	4.4
Nov. 4, 2011	55869	6.5
Oct. 25, 2011	55859	8.5
Oct. 15, 2011	55849	9.6
Oct. 5, 2011	55839	10.8
Sep. 25, 2011	55829	10.6
Sep. 15, 2011	55819	10.3
Sep. 5, 2011	55809	9.3
Aug. 26, 2011	55799	8.8
Aug. 16, 2011	55789	6.9
Aug. 6, 2011	55779	5.9

3. BROADCAST OUTAGES OVER FIVE MINUTES AND WWVB PHASE PERTURBATIONS

OUTAGES OF 5 MINUTES OR MORE						PHASE PERTURBATIONS 2 ms			
Station	Jun 2012	MJD	Began UTC	Ended UTC	Freq.	Jun 2012	MJD	Began UTC	End UTC
WWVB	06-25-12	56103	0336	0436	60kHz				
	06-11-12	56089	0623	0736	60kHz				
WWV	06-12-12	56091	2143	2250	2.5, 5, 10, 15, 20 MHz				
WWVH									

4. NOTES ON NIST TIME SCALES AND PRIMARY STANDARDS

Primary frequency standards developed and operated by NIST are used to provide accuracy (rate) input to the BIPM. NIST-F1, a cold-atom cesium fountain frequency standard, has served as the U.S. primary standard of time and frequency since 1999. The uncertainty of NIST-F1 is currently about 3 parts in 10^{16}.

The AT1 scale is run in real-time by use of data from an ensemble of cesium standards and hydrogen masers. It is a free-running scale whose frequency is maintained as nearly constant as possible by choosing the optimum weight for each clock that contributes to the computation.

UTC(NIST) is generated as an offset from our real-time scale AT1. It is steered in frequency towards UTC by use of data published by the BIPM in its *Circular T*. Changes in the steering frequency will be made, if necessary, at 0000 UTC on the first day of the month, and occasionally at mid-month. A change in frequency is limited to no more than ±2 ns/day. The frequency of UTC(NIST) is kept as stable as possible at other times.

UTC is generated at the BIPM by use of a post-processed time-scale algorithm and is not available in real-time. The parameters that we use to generate UTC(NIST) in real-time are therefore based on an extrapolation of UTC from the most recent available data.

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5. UTC(NIST) – AT1 PARAMETERS

The table below lists parameters that are used to define UTC(NIST) with respect to our real-time scale AT1. To find the value of UTC(NIST) - AT1 at any time T (expressed as a Modified Julian Day, including a fraction if needed), the appropriate equation to use is the one for which the desired T is greater than or equal to the entry in the T_0 column and less than the entry in the last column. The values of x_{ls}, x, and y for that month are then used in the equation below to find the desired value. The parameters x and y represent the offsets in time and frequency, respectively, between UTC(NIST) and AT1; the parameter x_{ls} is the number of leap seconds applied to both UTC(NIST) and UTC, as specified by the IERS. Leap seconds are not applied to AT1.

$$UTC(NIST) - AT1 = x_{ls} + x + y^*(T - T_0)$$

Month	xls (s)	x (ns)	y (ns/d)	T0 (MJD)	Valid until 0000 on: (MJD)
Aug 12	-35	-379532.7	-37.7*	56140	56171
Jul 12	***-35***	-3783640	-37.7	56109	56140*
Jun 12	-34	-377233	-37.7	56079	56109
May 12	-34	-376705.2	-37.7	56065	56079
May 12	-34	-376059.2	-38	56048	56065†
Apr 12	-34	-374919.2	-38	56018	56048
Mar 12	-34	-373741.2	-38	55987	56018
Feb 12	-34	-373399.2	-38	55978	55987
Feb 12	-34	-372643.2	-37.8	55958	55978†
Jan 12	-34	-371471.4	37.8	55927	55958
Dec 11	-34	-370293.4	-38.0	55896	55927
Nov 11	-34	-370027.4	-38.0	55889	55896
Nov 11	-34	-369158	-37.8	55866	55889†
Oct 11	-34	-368477.6	-37.8	55848	55866
Oct 11	-34	-367983.6	-38.0	55835	55848†
Sep 11	-34	-367185.6	-38.0	55814	55835
Sep 11	-34	-366841.8	-38.2	55805	55814†
Aug 11	-34	-365654.5	-38.3	55774	55805
Jul 11	-34	-364467.2	-38.3	55743	55774
Jun 11	-34	-363318.2	-38.3	55713	55743
May 11	-34	-362130.9	-38.3	55682	55713
Apr 11	-34	-361288.3	-38.3	55660	55682
Apr 11	-34	-360980.3	-38.5	55652	55660†

† Rate change in mid-month

***Provisional value**